

*The*  
**PROTECTION and PURIFICATION**  
*of*  
**RURAL WATER SUPPLIES**



**OREGON STATE BOARD OF HEALTH**  
Division of Sanitary Engineering  
Portland



# The Protection and Purification of Rural Water Supplies



1943

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STATE PRINTING DEPT.

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## FOREWORD

This pamphlet discusses a few of the fundamental features of a rural water supply, and outlines some of the necessary precautions in the construction and operation of such a supply. It must be realized, however, that every case is an individual one and that no general recommendations can be made to fit all conditions. If difficulty is encountered after carefully studying the information given here, field assistance may be rendered by the County Health Officer or Sanitarian upon request. Inquiries should not be directed to the State Board of Health unless accompanied by *complete* information, including descriptions, distances and sketches pertaining to the water supply and to all possible sources of human and animal contamination.

# PROTECTION AND PURIFICATION OF RURAL WATER SUPPLIES



## INTRODUCTION

Aside from air itself, water is the most essential commodity known to man. Without an adequate supply of good water, all life on earth would soon vanish. Yet it is surprising how little attention people sometimes pay to the production and protection of such a necessary commodity. This is especially true of people who have always lived in cities and towns having carefully-maintained public water systems. If water flows from the tap in good quantity and if it is cool and tasty, people are apt to give no further thought to the problems involved in obtaining an adequate and safe supply. On farms, though, or in suburban areas without access to public water supplies, these problems are very real and sometimes very dangerous.

It is now generally known that contaminated water is often responsible for the transmission of certain diseases and intestinal upsets including typhoid and paratyphoid fevers, dysentery, diarrhea, cholera, and infantile paralysis. It must be stressed that *all* polluted waters do not necessarily contain disease organisms, but if there is *any possibility whatsoever* for the entrance of human wastes or sewage into a water supply, no matter how distant from the point of use, that supply is a *potential carrier of disease*.

Animal contamination of water is not generally associated with the transmission of specific diseases. However, it is quite possible that large amounts of animal waste matter in a water supply may cause intestinal upsets in sensitive persons. Aesthetically, too, it is not comforting to know that water to be used for drinking may contain animal wastes.

**Dairy water supplies** must be especially well protected against the entrance of contamination, because of the very rapid growth of many types of bacteria in milk. Water containing only a few disease germs might not result in a case of disease when consumed by healthy, resistant persons, but when the water is used in and around milk containers the few disease germs may multiply in the milk to many thousands, thereby possibly spreading disease to users of the milk.

## LOCATION OF RURAL WATER SUPPLIES

The location of any water supply will depend upon the amount of water available, the pumping requirements, the geology of the area, surface slopes and elevations and—most important—the location of possible sources of pollution. Space will not permit a general discussion of all of these points, but the connection between sources of pollution and the safety of the supply should be pointed out.

Possible sources of human contamination include pit privies, cesspools, septic tank seepage fields and dry-wells, leaky sewer lines, and deposits of human waste material on the surface of the ground or in sources of water. Animal pollution may come from barn and barnyard drainage, percolation from manure piles and chicken yards, or any deposit of animal waste matter on the surface of the ground or in sources of water.

As a general rule it may be said that water supplies should be kept *as far as possible* from any of the above sources of contamination. Under no circumstances should shallow wells be closer than 100 feet to any of them. Shallow springs should be located so that there is no contaminating influence above them.

If contamination is reaching underground water strata, wells or springs drawing from those strata—whether shallow or deep—may be dangerous, no matter where they are located. *The “filtering effect” of natural earth formations cannot be depended upon to remove all bacteria from polluted ground water.*

In general, wells and springs located on high ground are safer than those on low ground. All supplies should be located above possible flood levels of nearby streams. *Animals should be fenced away from the vicinity of any water supply of any type.*

In the interest of general sanitation as well as the location of the water supply, all sewage or waste disposal facilities must be carefully constructed and maintained. Pit toilets and cesspools must never be so deep that they might contaminate any ground waters, nor so shallow that they might affect surface waters or be accessible to insects. All sewer lines must be tight at all points. Effluent or water from septic tanks must be leached *into the top soil* so that it neither reaches underground water nor comes to the surface nor enters any stream. *Septic tank effluent is just as dangerous as raw sewage.* (This is discussed in a bulletin entitled “Sanitary Sewage Disposal for Rural and Suburban Areas,” which will be supplied upon request.)

## COMMON METHODS OF DEVELOPMENT

Before describing the features of sanitary construction of the various types of water supplies, it is well to define the common methods of development, both good and bad.

**A shallow dug well** is a 3- to 6-foot diameter hole dug down to a shallow ground water stratum, usually not over 30 feet deep and commonly from 15 to 20 feet deep. It may be lined or unlined, depending upon the character of the earth. The water is drawn up with a power-driven pump, hand pump, or even with a bucket and a rope in some cases. *Most rural water supply troubles are with shallow dug wells.*

**A driven well** is developed by means of a pipe equipped with a strainer and driving point on the lower end. The pipe is driven through the top soil until it reaches an accessible ground water stratum. Because of the nature of its construction, a driven well is necessarily *shallow*, usually not over 20 feet in depth. Water is drawn up either with a power-driven or hand-operated pump.

**A drilled well** is developed by boring a hole through the earth with mechanical equipment. The hole is usually cased with metal casing or pipe, to prevent the earth from caving in and to seal out surface contamination. There is practically no limit to the depth obtainable, provided the proper type of pump is used. Inasmuch as the water in drilled wells is often deep, special deep-well pumps may be used to force the water upward.

**A spring** is merely the intersection of a ground water stratum with the surface of the ground. If the spring water is from shallow sources, it can be considered the same as that found in shallow wells. If, on the other hand, the spring water is from deep underground sources, it can be considered the same as that obtained from deep wells.

**A surface water supply**, as the name implies, is derived from some surface body of water such as a creek, canal, river or pond. Such water may be plentiful, but it is seldom safe for domestic use without adequate treatment.

## SANITARY CONSTRUCTION OF RURAL WATER SUPPLIES

### Shallow Dug Wells.

Primary attention must be given to the *exclusion of surface water* from the ground water supply. A water-tight casing or lining should be provided to a depth beyond the possible reach of surface water. Such a lining should be constructed of a good quality concrete,

poured without holes or joints and extending a foot above the surrounding ground.\* In the water-bearing stratum itself, of course, the lining must be perforated or made of unmortared brick so that water may enter the well.

If large pipe tiles are used to line a dug well, they should be completely surrounded with cement grout to the necessary depth. Dependence should not be placed upon the tightness of the tile joints themselves, as they can easily crack and leak after placement. If corrugated pipe is used to line a dug well, the joints should be welded, not riveted.

The depth to which the water-tight lining must be extended is variable, depending upon soil conditions, surface slopes, and the proximity of sources of pollution. A comprehensive survey of surrounding conditions is necessary before a conclusion can be reached. Depths which are quite adequate in many parts of the country are *entirely inadequate* in most of western Oregon, due to the abundance of surface water and the consequent greater depth of influence of surface contamination. In fact, there are large sections of western Oregon in which the upper ground water tables themselves are polluted by surface waters and possibly by sewage. Obviously, under such conditions it is useless to try to exclude surface contamination from shallow wells. The only possible advice in this case is to avoid the use of such water, or to give it adequate and continuous disinfection.

To further protect a well supply from surface contamination, there must be a *water-tight cover* (preferably of reinforced concrete\*) completely over the top of the well. If a manhole is desired, it must be designed so as to prevent surface leakage or flooding. If possible, the pump should be mounted *away* from the well so as to prevent water, oil drippings and incidental contamination from running back into the well. In the case of a direct-acting pump which must be mounted over the well, the pump base should be bolted and *sealed* to the well cover. The area around the well should be back-filled with tight clay, thoroughly tamped and sloped away from the well. (See Figure 1). The entire vicinity of the well should be fenced against animals.

### Driven Wells.

The remarks concerning shallow dug wells also apply to driven wells. In this case the drive pipe itself forms the water-tight casing,

\* Concrete used in building water supply structures should be carefully prepared and placed, using a 1:2:4 mix—one part of cement to two parts of clean sand to four parts of clean gravel or broken rock, by volume. Use only enough water to wet the mix—not over 7 gallons of water to each bag of cement. Tamp thoroughly when pouring the concrete.

# TYPICAL DUG WELL CONSTRUCTION

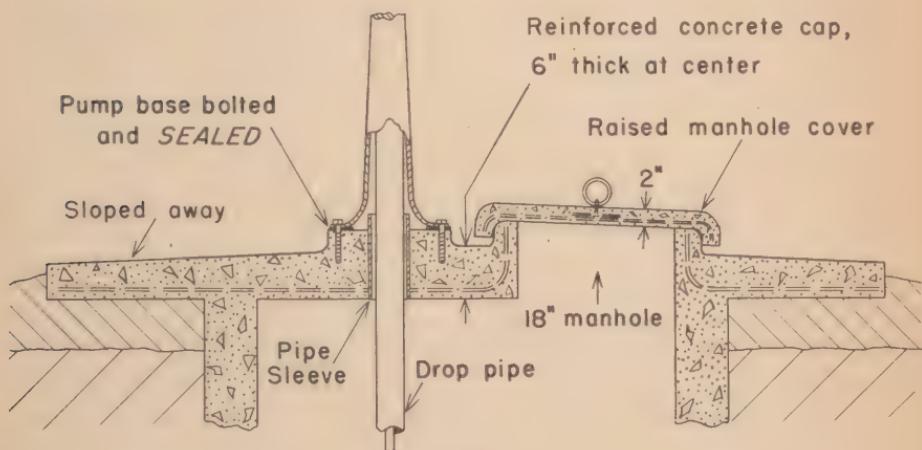
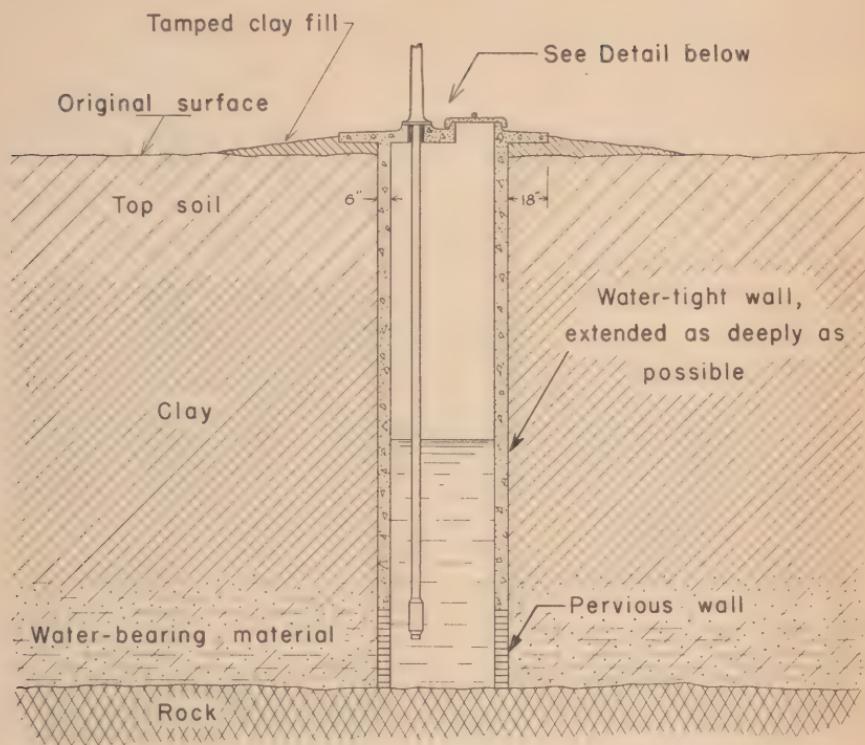


Figure 1

but the depth necessary to reach safe water is still dependent upon the character of the soil and the proximity of sources of pollution. A driven well should be capped with a wide water-tight apron through which the well pipe extends and to which the pipe or pump base should be sealed. The area around the well should be back-filled with tight clay, tamped, sloped and fenced as for dug wells. (See Figure 2.)

## TYPICAL DRIVEN WELL CONSTRUCTION

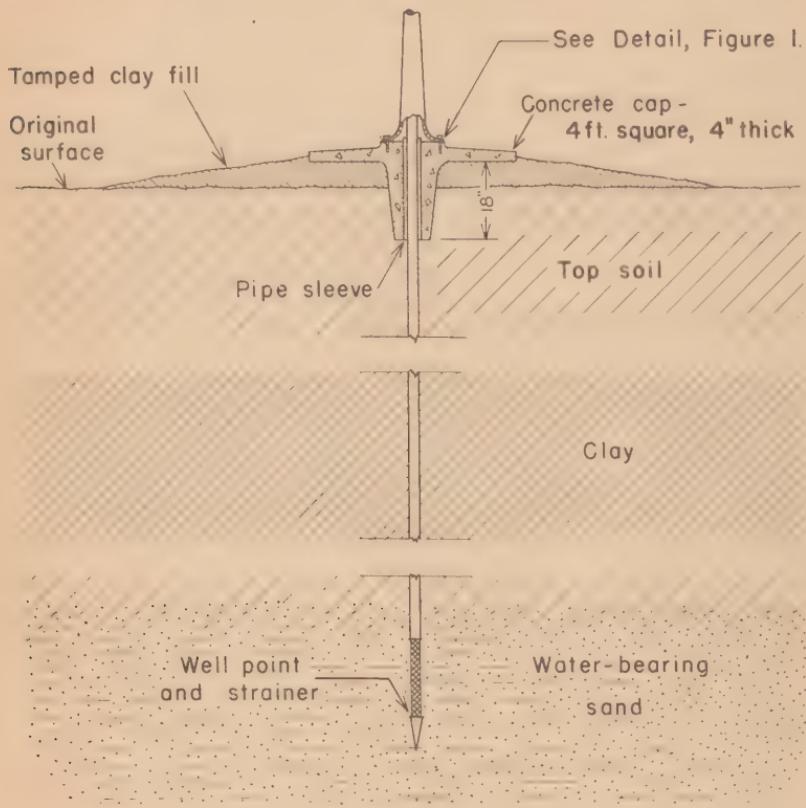
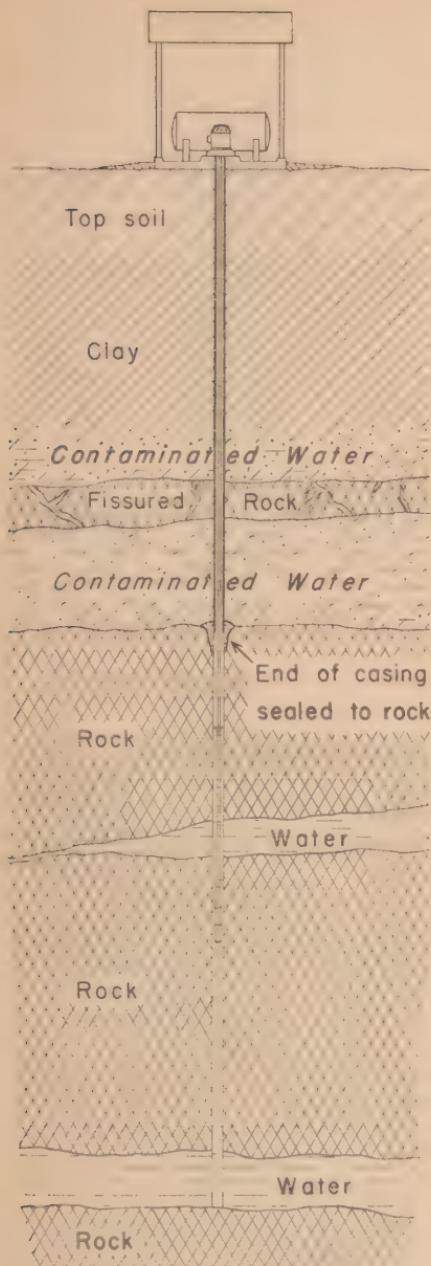


Figure 2

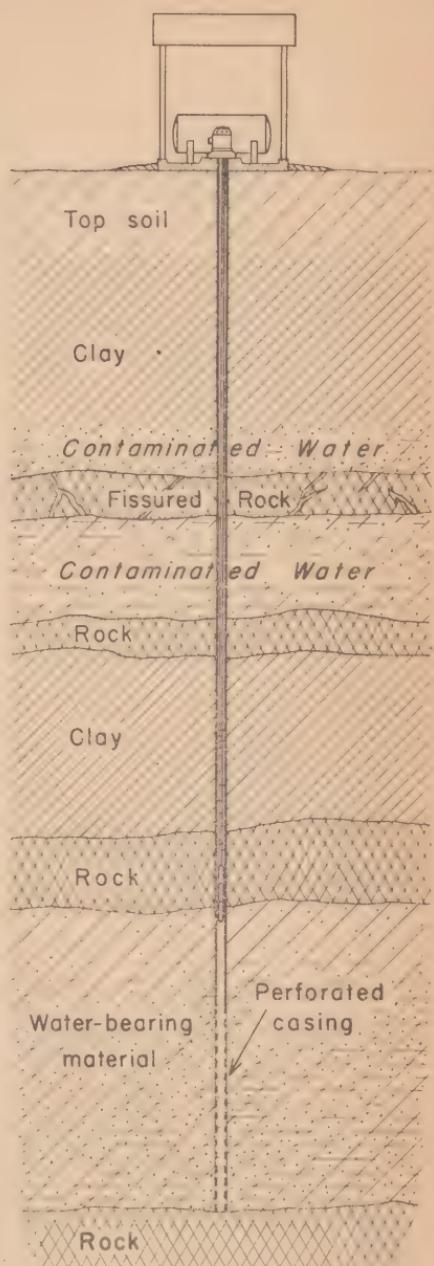
### Drilled Wells.

Drilled wells should be carried downward to a safe water-bearing stratum, at least 50 feet deep and more if possible. It is important to drill through one and preferably two or three impervious strata before drawing ground water. The casing should then be driven as far as possible into a solid rock stratum and sealed with cement grout to keep surface water from following

# TYPICAL DRILLED WELL CONSTRUCTION



(a) Cased only to rock



(b) Cased to full depth

down the outside of the casing and entering the water supply. An even safer procedure is to use an outside casing sealed to rock, with an inside casing down to water. The two casings may then be sealed together. The casing should be of heavy gauge wrought iron or steel, with threaded joints, and should extend a foot above the ground level when completed. A drilled well should be capped as directed above for a driven well. (See Figure 3.)

A word of caution should be given regarding the "perforating" of drilled well casings. In order to increase the yield of a deep well the driller will sometimes perforate or pierce the casing after it is in place, along the zones which are water-bearing. As long as these zones are deep no harm will result. However, if the perforations are shallow, the sanitary advantages of having a deep well will be lost. From a sanitary standpoint, *a well is no deeper than its uppermost opening*, whether the opening is a perforated or cracked casing or a leaky well cap. Any good well-driller should be acquainted with these precautions.

Deep wells, when properly constructed and operated, are probably the safest type of rural water supply. Occasionally, however, it is found that cracks and fissures reaching deep ground water may introduce surface water or sewage. Sometimes the offending stratum may be cased off; otherwise the supply should be either continuously treated or abandoned.

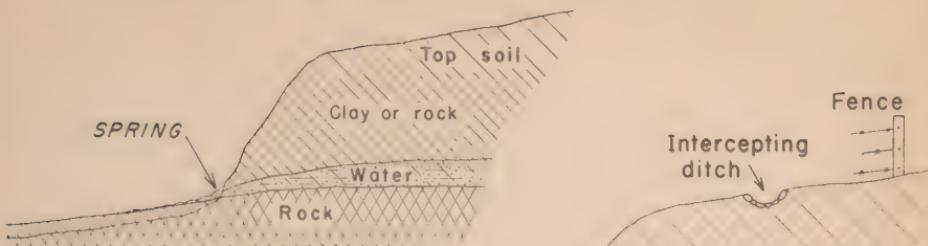
## **Springs.**

As in the case of wells, primary attention must be given to the *exclusion of surface water from springs*. A diverting ditch should be dug several feet from the spring area and *completely around it* on the uphill side. The spring itself should then be developed so as to protect it from all surface contamination and from access by animals. (See Figure 4.)

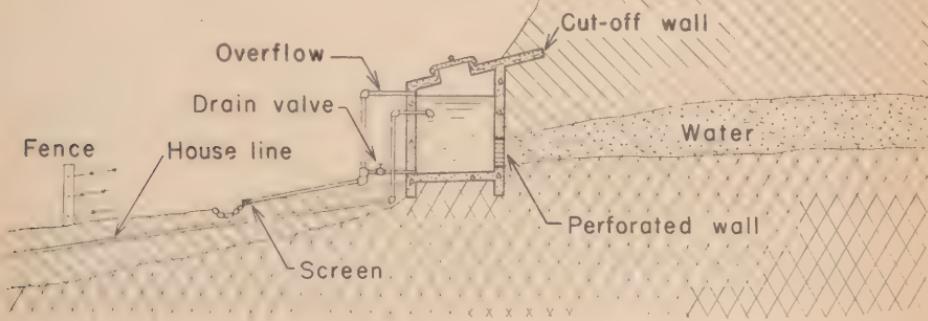
If the spring area is wide-spread and slow in flow, it may be necessary to install underground collecting tiles which will convey the ground water to a collecting box. The tile lines may be laid in gravel if necessary to assist the flow, but great care should be taken to use only clean sanitary gravel. The lines should be covered with an impervious clay or concrete layer to exclude surface water. If the spring is fairly well centralized, it will be sufficient to use a collecting box alone, of a size that will adequately cover the spring area. In this case the back side or bottom, depending on the nature of the flow, will be open or perforated to allow entrance of the water.

In any case, the collecting box must be of tight construction, preferably of concrete (See foot-note, page 8). It should be care-

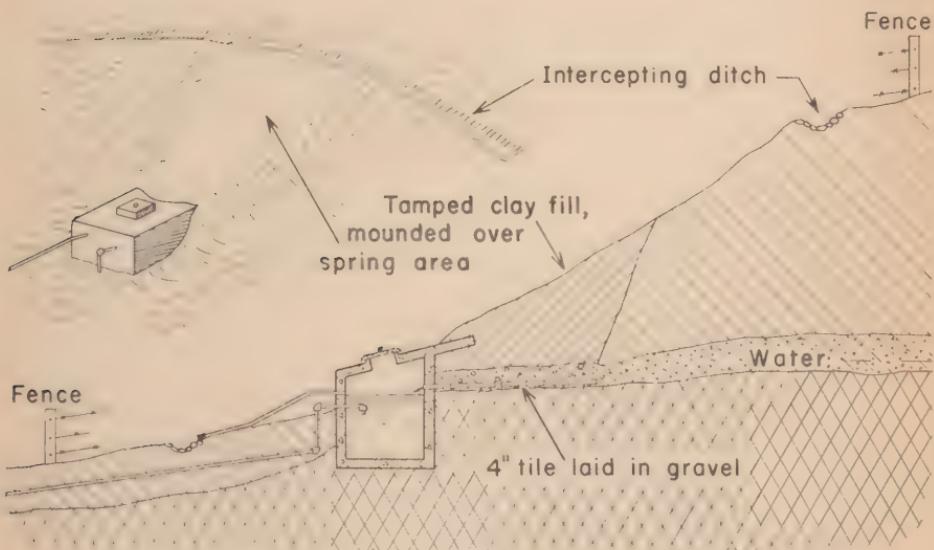
# TYPICAL SPRING CONSTRUCTION



(a) Typical spring, before development



(b) Proper method of development



(c) Collection system (to increase yield from slowly-flowing springs)  
Thirteen

fully covered as described for dug wells. The box should have an overflow pipe, screened to prevent the entrance of insects and rodents. A bottom drain pipe and valve may be added if it is thought that sediment may collect in the box. (See Figure 4 for suggested details.)

As was pointed out previously, springs producing water from shallow sources may be considered as subject to the same dangers as shallow wells. Likewise, deep springs may be considered as subject to the same conditions as deep wells; that is, they are usually excellent sources of water, but occasionally they may be subject to deep percolation of polluted water. If such is the case, the supply should either be continuously treated or abandoned.

### **Surface Supplies.**

Occasionally, the only possible source of domestic water for a rural home will be a surface stream, a pond or a river. In general a surface supply is not satisfactory unless the entire watershed is *effectively and completely closed to humans and animals*—a condition rarely if every possible. If any animals have access to the watershed, a water of poor quality is apt to result; and if any *humans* have access to the watershed, the water will be *dangerous*.

Surface waters generally have a much greater amount of foreign matter—leaves, humus, silt, vegetable and mineral color, etc.—than have ground waters. Such material will result in water of a poor quality which will be difficult to disinfect. Filtration might even be necessary to remove some of the foreign matter before disinfection. In certain parts of the state, the only water available for domestic and farm purposes alike is brought in through irrigation canals or ditches. Almost invariably, such water should be filtered and disinfected before being used for domestic purposes.

Details concerning the development and treatment of such surface supplies will not be considered here. Individual cases may be described to the State Board of Health and suggestions requested, or the services of a consulting sanitary engineer may be engaged.

### **Pumping Facilities.**

Any water supply pump must be designed for the particular type of use required and must be built to give unfailing service. Modern power-operated pumps are satisfactory from a sanitary standpoint, but certain hand-operated pumps should be avoided. These include pumps requiring priming, by which the well water may become contaminated directly, and pumps with split bases which cannot be properly sealed to the well cap. The use of a bucket and rope

is obviously dangerous, as the proper protection against surface contamination cannot be given when the well cap is being opened at frequent intervals.

As a general rule, the use of a pump pit located below ground level should be avoided. Such a pit may become flooded with surface water and may endanger the safety of the supply. If the pump is located in the house basement, adequate drains should be provided. If a *suction* pump is installed in the basement, at a distance from the well, the suction pipe should be protected by a sealed protective casing. (See Figure 5.)

## PROTECTION OF UNDERGROUND SUCTION

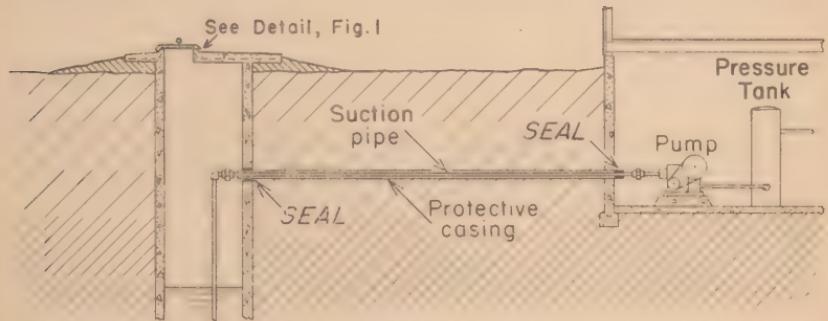


Figure 5

### Storage Facilities.

Once a water supply source is properly developed, the water should be protected from all possible subsequent contamination. Storage in steel tanks which are a part of the regular pressure system is usually above suspicion. Storage in open tanks or reservoirs, however, is often unsatisfactory. All such structures should be completely roofed and walled, with all openings screened. Above-ground tanks should be protected against dust and other air-borne contamination. Manholes should be provided for inspection and occasional cleaning. Care must be taken to design manhole covers so as to prevent leakage of surface water into the stored water. (See Detail, Figure 1.)

## PURIFICATION OF RURAL WATER SUPPLIES

A water supply which has been properly located and constructed should yield water of a safe sanitary quality. However, disinfection of the source is usually necessary at first, and continuous disinfection of the water itself may also be necessary in certain cases.

## Disinfection of the Source and Distribution System.

After the construction of a new water supply, or after cleaning or repairing an existing supply, the water usually will be found to be temporarily contaminated. This is because of the presence of dirt washed in or brought on workmen's feet, tools, etc., or because of the use of contaminated well casing or pipe. The entire system should be flushed out, then sterilized with a chlorine solution according to the following directions:

- (1) Calculate the total number of gallons of water in the well or spring, in the pipe lines and in the storage tanks.

The capacity of a circular well or a cylindrical tank may be estimated from the following table:

Table I

Approximate Capacities of Circular Wells or Cylindrical Tanks									
Diameter	4 in.	6 in.	8 in.	1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.
Gallons per foot of depth or length	.65	1.5	2.6	6	24	53	94	147	212

Multiply the proper lower figure by the depth of water in the well or length of tank, in feet, to get the total gallonage. Examples: A 6" well with an 80-foot depth of water will contain  $1.5 \times 80 = 120$  gallons. A tank 3 feet in diameter and 10 feet long will contain  $53 \times 10 = 530$  gallons.

The capacity of a rectangular well, box or tank is found by multiplying the length by the width by the height, all in feet, then multiplying by  $7\frac{1}{2}$ . This will give the total gallonage. Examples: A dug well 4 feet square and with 20 feet of water will contain  $4 \times 4 \times 20 \times 7\frac{1}{2} = 2400$  gallons. A spring box 4 feet wide, 5 feet long and 3 feet high will contain  $4 \times 5 \times 3 \times 7\frac{1}{2} = 450$  gallons.

(2) For every 100 gallons of water, as calculated above, prepare  $\frac{1}{2}$  gallon of 1 per cent chlorine solution. Example: For a total water capacity of 800 gallons, prepare  $8 \times \frac{1}{2} = 4$  gallons of 1 per cent chlorine solution. The preparation of chlorine solutions is described on page 18.

(3) Pour the proper amount of chlorine solution into the well, spring or reservoir, mix thoroughly and allow to stand for 24 hours.

(4) In the case of well disinfection, the chlorinated water should be circulated by pumping it from the well and discharging it back into the well through a hose or pipe, before the standing period is begun.

(5) In all cases pump the chlorinated water through the entire system—pipes, tanks, coils, etc.—running the water through the various faucets until the odor of chlorine is discernible.

## Continuous Disinfection of the Water.

In spite of all possible care in construction, there will be an occasional water supply in which the incoming water itself may be

contaminated. This may be due to an unavoidably poor location, to unforeseen peculiarities in the ground water flow, or to the unavoidable use of surface water. In such cases, all water to be used for drinking or cooking purposes should be disinfected *at all times*. If the quantity of water used each day is small, it is simplest and safest to treat it in batches. Three simple methods of batch disinfection are outlined here.

Method A: Boil the water briskly for a few minutes, allow to cool and store in a clean covered container. If the taste is flat, pour the water back and forth from one container to another to allow air to be absorbed. This is the simplest and safest method for treating small volumes of water.

Method B: Use ordinary household tincture of iodine (7%). For each gallon of clear water to be treated, add 5 drops of iodine. For muddy or mossy water, use 15 to 20 drops of iodine to each gallon of water. Then stir well and allow to stand for 30 minutes. At the end of that time the water should still have a distinct medicinal taste; if not, add more iodine. If the taste is too objectionable, it may be removed by adding a small crystal of photographic fixer or hypo (sodium thiosulfate). *Do not add hypo until after the treated water has been allowed to stand for 30 minutes.*

Method C: Use ordinary household bleach or chlorine disinfectant diluted to a strength of 1% available chlorine. (See Table III for the preparation of 1% solutions.)

Table II below gives the amount of 1% solution required to sterilize various quantities of water, provided the water is clear and only moderately polluted. *If the water is muddy, mossy or heavily contaminated, use 3 times the amount of 1% chlorine solution shown in Table II.*

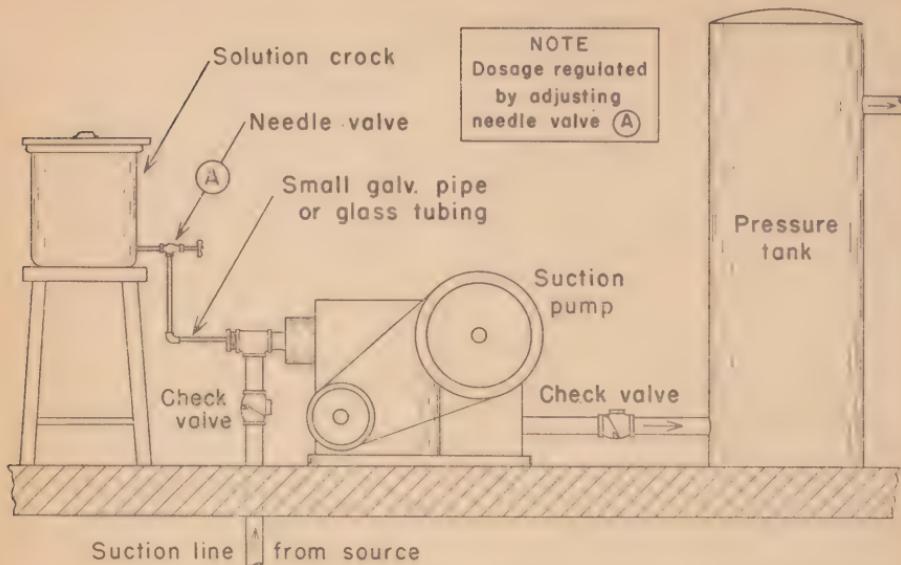
Table II  
Disinfection of Various Quantities of Water

Volume of water to be sterilized	Amount of 1% chlorine solution required
1 gallon	5 drops
2 gallons	10 drops
5 gallons	25 drops
10 gallons	50 drops
50 gallons	3 teaspoonsful
100 gallons	6 teaspoonsful
500 gallons	9 tablespoonsful
1000 gallons	½ pint (1 cup)

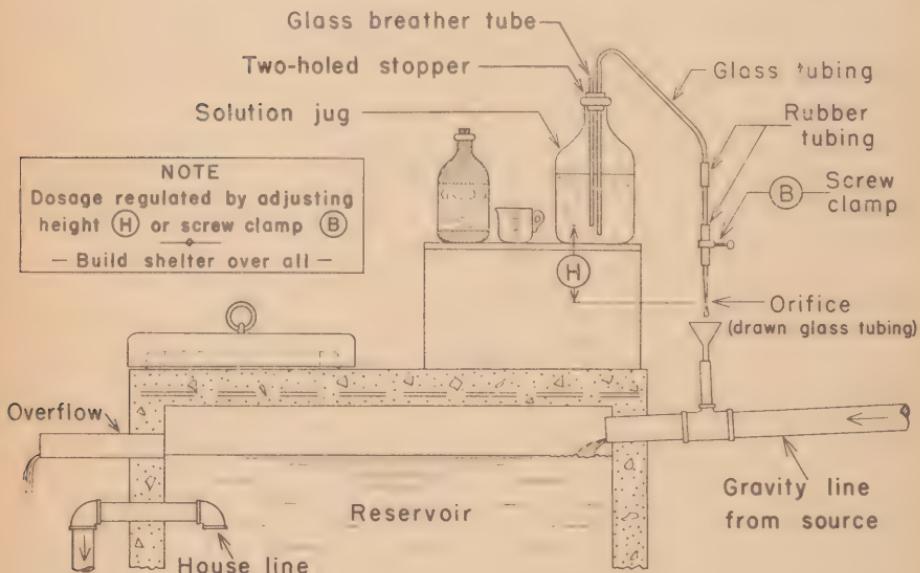
**Caution: Do not use a silver spoon for measuring chlorine solution.**

Add the correct amount of chlorine solution, stir well, and allow to stand for at least 30 minutes. At the end of that time the water should still have a slight chlorinous taste; if not, add more chlorine. Removal of excess taste, *after 30 minutes*, is discussed under Method B, above.

# CHLORINE DOSING DEVICES



(a) Automatic suction-pump system



(b) Constant-flow gravity system

If the daily consumption of water is fairly large, as in a dairy or large household, continuous treatment of the running water would be more efficient. Patented mechanical chlorinators are available to fit the disinfecting requirements of any type of a supply, and they are recommended as the best and safest devices for the continuous sterilization of water. However, their cost may make them prohibitive for many farm and residential installations.

As a substitute any good mechanic can build out of readily available material a chlorinator which, while not as accurate or as automatic as a commercial chlorinator, will still be adequate in many cases. Another type of dosing device can be made in any high school chemistry laboratory. Two such examples of "home-made" chlorinators are shown in Figure 6. Either of these devices can be adjusted to use 1 per cent chlorine solution, in the quantities shown under Method C above. An estimate should be made of the total water consumption in a day; then the chlorinator may be regulated to deliver the appropriate amount of chlorine solution (from Table II) in a day's time.

It must be stressed that if a contaminated water supply is being disinfected for domestic use, the treatment must be *adequate* and *continuous*. The treatment device must be maintained in good condition at all times. The chlorine solution must be prepared carefully and the container never allowed to run dry. In short, private water supplies requiring treatment will be a continual source of bother and concern to those using them, and their use cannot be recommended. *It is worth a tremendous amount of care and effort to obtain safe water in the first place.*

### **Preparation of Chlorine Solutions.**

There are several forms of chlorine on the market, some powdered and some already in solution. For the small amounts to be used in treating a domestic water supply, one of the solution forms is usually simpler to use, but the powdered forms are perfectly satisfactory if freshly opened and if properly handled. Below is a list of some common sources of chlorine, the form in which they are sold, and the amount of each type necessary to make one gallon of 1 per cent stock chlorine solution.

Table III

## Preparation of 1% Chlorine Solution from Various Chlorine Products

Product	Form	% available chlorine *	Amount required to make 1% chlorine solution, when diluted to 1 gallon*
Purex		3%	5 cups + 6 tablespoons
Clorox			
Hypro			
White Magic			
Nubora			
Sani Clor			
White Rose			
Master X			
Clor	Solution	15%	1 cup + 4 teaspoons
Diversol	Powder	3%	3 pounds
HTH-15	Powder	15%	10 ounces
Chlorinated lime	Powder	25%	6 ounces ( <i>fresh</i> powder)
B-K	Powder	50%	3 ounces
HTH-70	Powder	70%	2 ounces
Perchloron	Powder	70%	2 ounces

\* Note: As the available chlorine in any of these products is subject to change by the manufacturer, the strength given on the label should always be checked before using. If it has been changed from the strength given here, adjust the dilution accordingly.

When using the solution forms, merely dilute the proper amount of chlorine solution shown above with water, enough to make one gallon of solution. This solution must be stored in tightly stoppered bottles, in the dark. It will gradually lose its strength so too large a stock should not be made ahead.

When using the powdered forms, it is best to mix the proper amount of *fresh* chlorine powder shown in Table III with a small amount of water, making a paste, then gradually dilute to one gallon and allow to settle. If much inert material settles out, the clear solution should be carefully poured off; then the solution should be stored in tightly stoppered bottles, in the dark. This solution will lose its strength in a few weeks, so it must be made up frequently. Be sure to use only *fresh, newly opened* chlorine powder.

## CHEMICAL QUALITY OF RURAL WATER SUPPLIES

### Hardness.

Most of the complaints dealing with the chemical quality of water concern the hardness. This is especially true in the case of deep wells, where the water may have become highly mineralized while passing through the earth. The ordinary chemical treatment methods for the removal of hardness would not be practical on a small scale, but there are on the market a variety of commercial "zeolite filters," which will remove most of the hardness from water. They are relatively expensive for small installations, and the development of a better water supply might be less costly. The names of manufacturers of such equipment will be sent upon request.

### Iron or "Red Water".

Many complaints dealing with the chemical quality of water concern "red water" or dissolved iron. This condition may be due to either of two causes: the water may be so corrosive that iron pipes, well casings and tanks will be badly rusted and the rust will appear in the water, or the ground water itself may contain abnormal amounts of dissolved iron. In either case the result will be a distasteful water and stained plumbing fixtures, dishes, laundry, etc.

If the ground water itself is not high in iron but is so corrosive that it gives rise to "red water," the water may be rendered non-corrosive fairly simply. A dilute solution of hydrated lime (calcium hydroxide) may be introduced into the supply line in much the same manner as described for the introduction of chlorine solution in continuous chlorination. (See Figure 6.) Care should be taken not to use too heavy a dosage of hydrated lime or the piping may become scaled and clogged. Another chemical which will usually give adequate results is sodium hexametaphosphate, prepared in a form especially adapted to small water supplies.

If the ground water itself is high in iron, there is no simple process by which the water may be rendered unobjectionable. The best advice is to seek a better water supply or else resort to one of the intricate and often costly treatment processes which may be helpful. The descriptions of commercial iron-removal processes will be sent upon request; or the services of a consulting engineer may be engaged.

## MAINTENANCE OF RURAL WATER SUPPLIES

Mechanical devices such as pumps will of course have to be maintained the same as any other mechanical equipment. They must be kept clean, oiled or greased when necessary, and the washers and packing glands maintained in good operating condition.

*Wells and springs will not require cleaning if they are properly constructed.* Likewise, reservoirs and tanks holding water which has been properly protected should not require frequent cleaning. However, the storage of certain waters will result in slime or moss growths, which should be removed at intervals to avoid objectionable tastes. The material may be scraped or brushed off, then the walls and floor brushed with a strong chlorine solution. The reservoir or tank may then be rinsed out and put back into service.

Above-ground reservoirs and tanks should be inspected at intervals to make certain that they are well screened against the entrance of rodents and insects. Underground tanks, reservoirs, well casings, well caps, etc., should be inspected at intervals for cracks which would allow ground water seepage to enter. If cracks are found, they should be cleaned and roughened, then filled with cement grout or tar.

Occasionally a drilled or driven well casing will rust out, due to thin gauge material or to corrosive soil or water. This may endanger the safety of a deep well supply. It should be corrected at once by pulling the old casing and replacing it, or by driving a new casing inside of the old one.

Every time a well, reservoir or spring box is entered for inspection, and every time a pump or a part of the distribution system is repaired or replaced, the *affected part of the system should be chlorinated.* Directions will be found on page 16.

## WATER ANALYSES

The State Board of Health and certain county and local health departments maintain laboratories which will make bacteriological analyses of water without charge. Certain private laboratories also make water analyses. The health department laboratories do not make chemical analyses of water; these must be done by a private laboratory.

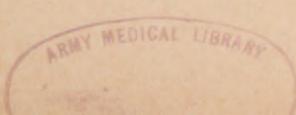
The standard bacteriological test for the purity of water is a test for the presence or absence of a group of bacteria called the "coli-aerogenes group". These particular bacteria are most common in the intestines and intestinal discharges of humans, birds and other warm-blooded animals, and are seldom found elsewhere in nature. Their presence in a water sample indicates that the water

has been exposed to animal or human contamination and is therefore dangerous to use for drinking. *The standard test for the purity of water does NOT indicate the presence or absence of disease germs. Instead, it indicates the presence of contamination which could easily be accompanied by disease germs if they happened to be present.*

The analysis of *one sample*—whether it is good or bad, whether it is tested in the State Laboratory or in a private laboratory—is not sufficient evidence to determine whether a particular water supply is safe or unsafe. A number of samples over a period of time are necessary to form a conclusive opinion.

Furthermore, water samples should never be considered until a sanitary survey of the water supply has been made, and any necessary corrective measures have been taken. Such a survey should be made by a representative of the health department. If that is not possible, anyone with good judgment can determine whether or not a supply is safe from sanitary hazards by following the suggestions made in this bulletin. *Sampling a water supply which is subject to any sanitary hazards is a waste of time and may be dangerously misleading.*

Water samples must be taken in properly sterilized containers, following careful sampling procedure. Samples should be taken and submitted by a representative of the state or county health department whenever possible, as untrained persons sometimes contaminate a sample by taking it incorrectly. Call or write to your County Health Officer for further information.



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